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BEE KEEPING'S IMPACT ON SUSTAINABLE LIVELIHOODS DEVELOPMENT IN BAJAUR AGENCY PAKISTASN

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ABSTRACT

Beekeeping or apiculture provides nutritional, economic and ecological security to rural communities as an additional income generating activity. The study was conducted to analyze the impact of honeybee keeping on the sustainable livelihoods development in Bajuar agency, Khyber PakhtunKhwa Pakistan. Primary data have been collected from randomly selected 80 beekeepers with the help of pretested schedule through research designed questionnaire. Descriptive statistics; frequency, mean and percentages were employed in data analysis. On average landholding of the beekeepers was 18.46 acres per household ranging from zero to 320 acres and the honey productivity per household was 1295 kg ranges from 10-6000 Kg. The mean beehives holding were 60.45 per household ranges from 2-665 hives. The average annual household income per beekeeper has been observed to be higher (Rs.527275) followed by the non-beekeeping sources (Rs.180300). The Pre and Post Beekeeping mean annual expenditures of the sample size household was Rs.164200 and Rs.257912 respectively. The major constraints listed by the beekeepers were shortage of effective bee flora during bee hives migration, pest and diseases attack, lack of professional training, extension services, credit facility and transportation. Most of the beekeepers have been observed to be potential or expand its production and productivity on sustainable basis.

KEYWORDS: Apiculture, Bee Flora, Bajaur Agency, Honey Byproducts, Honey Production, Pollinator

INTRODUCTION

Beekeeping orapiculture is the art, science and or business of rearing and managing honeybees for the purpose of producing honey, beeswax and other bee products for personal consumption, industrial use and producing honeybee hives for selling to other beekeepers. Honey bees are popular and economically beneficial insects. Bees have more than 20,000 species worldwide. However four different types of honey bees are found in all over Pakistan i.e Oriental bee (*Apis cerana*), Rock bee (*Apis dorsata*), little bee (*Apis florae*) commonly known as "shotee bee" and Occidental bee (*Apis mellifera*) (Quraishi and Khan, 1972).Oriental bee is known about its Asiatic origin locally termed as "Gharailvi Mhaki" commonly found in northern/western hills and foot hills of some part of Khyber PakhtunKhwa, Punjab and AJK. Rock bee and little bee found in foot hills, plains and semi desert areas in all provinces of the state (Noor *et al*., 2009) The first three species are indigenous and fourth one is imported in Pakistan which is native to America.

Honey bee keeping is a profitable business in Pakistan. About 7,000 beekeepers are now rearing *A. mellifera* species in modern beehives. About 400,000 honeybee colonies of *A. mellifera* bees produces 10,000 metric tons honey annually (Annual report PARC 2010-2011).Congenial climatic conditions and bee flora in the country provide excellent opportunities for the expansion of beekeeping. Bajauar Agency, KPK is highlyendowed with natural resources such

asnatural vegetation, annual and perennial crops, adequate water resources and large bee colonies which create conducive environment for beekeeping. Beekeeping strengths the livelihoods of rural communities and help them to become less vulnerable to different shocks and reduces the danger that they will fall into crisis (Nicola, 2009). However, majority of the rural households in the study area inclined to the other options of livelihoods. Because ruralcommunity doesn't have adequate knowledge in processing, preparing and marketing of honey products and byproducts for home consumption and other purposes. Though honey beekeeping proves to be an effective income generating activity for rural households. But only limited number of rural families earns their livelihoods from honey beekeeping.

Besides their medicinal and nutritional benefits honeybees can be a potential pollinator increasing yield of pollinating crops by more than 20 %. Also capable of providing honey, royal jelly, pollen, propolis and beeswax. The production and value addition of by-products would supplement the income of beekeepers in the future (Marwat *et al*., 2013). Hence the research project entitled "Honeybee Keeping's impact on sustainable livelihoods development in Bajaur Agency" wasaimed to be undertaken with the following objectives:

- To examine the socio-economic characteristics of beekeepers.
- To determine the contribution of beekeeping to annual household income of the beekeepers.
- To trace out the problems and constraints faced by the bee keepers in honey beekeeping.
- To find out the solution for increasing bee hives and honey production.

MATERIALS AND METHODS

Universe of the Study

The study was conducted in Bajaur Agency, one of the smallest Agencies of the Federally Administered Tribal Areas (FATA) of Pakistan located in the Khyber Pakhtun Khwa Province. Study area was grouped under high potential for beekeeping covered with natural vegetation having adequate water resources and large bee colonies conducive for beekeeping. Bajaur Agency is spread over a distance of 65 Km east and west comprises on 826 Blocks and 46 Union Councils while subdivided into two sub-Divisions viz, Khar and Nawagai. Each sub division comprises four tehsils. There are total eight tehsils in the Agency. Due to limited availability of resources and time, study was undertaken to the sample frame of 80 Beekeepers obtained from the office of Non Timber Forest Products (NTFP), Forest Department FATA Bajaur Agency.

Research Design

This study was a cross-sectional research design based on collecting information from across section of population at one point in time. The information was collected, then organized and analyzed.

Sampling Procedure and Sample Size

A sample frame of 80 Beekeepers obtained from the NTFP office, Bajaur Agency as a target population. Out of total 27 no. of beekeepers were selected from Tehsil Salarzai, 27 from Khar and 26 beekeepers from Tehsil Nawagaiwere interviewed with the aid of a structured questionnaire. The total sample size (80 beekeepers) was grouped as Non Commercial Beekeepers and Commercial Beekeepers according to the number of their hives holding as under:

Category	Sample Size	No. of Hives Holding
Non Commercial Beekeepers	47.5 %	< 25
Commercial Beekeepers	52.5 %	> 25

Types and Sources of Data

For this research both qualitative and quantitative data was gathered. Primary data related to the research questions were collected on pre-tested schedule by adopting personal interview method from the selected beekeepers .Moreover, secondary data were gathered from the Agency NTFP Office, other relevant offices and forest department in order to supplement primary data.

Data Analysis

Data was collected through household survey and analyzed by using descriptive statistics; percentages, frequencies, paired sample t test and binomial proportion test. Moreover, Statistical Package for Social Scientist (SPSS) was used so as to fasten the analysis of the household's survey data.

RESULTS AND DISCUSSIONS

The results of the study were based on the responses of 80 beekeepers who owned a total 4836 beehives, with an annual average honey production of 53592 Kg and the annual average total income from the sale of honey was Rs.42873600 while their total average annual income from non-beekeeping source was Rs.1442400.

Educational Status of the Beekeepers

Education is the aggregate of all the process required for bringing about desirable change in human behavior. The educational acquisition of people plays a crucial role in enhancing their ability to acquire innovations faster. Regarding educational status of beekeepers Table No. 01 shows that 37.5% of the beekeepers had no formal education, 11.25% had primary education, 8.75% had middle education, 18.75 had secondary education, and 23.75 % had graduated education. This indicates that majority (87%) of the beekeepers had one form of educational background or the other; also these education levels imply that it would be a flexible society towards change. It should not encounter any difficulty in introducing new beekeeping techniques in this area.

Table 1: Distribution of Beekeepers on their of Educational Status (N= 80)

S.#	Educational Status	Non Commercial Beekeeper N (%)	Commercial Beekeeper N (%)
1	Primary	2(22.2)	7(77.8)
2	Middle	1(14.3)	6(85.7)
3	Secondary	11(73.3)	4(26.7)
4	Graduate	14(73.7)	5(26.3)
5	Illiterate	8(26.7)	22(73.3)
	Total	**38(47.5)**	**42(52.5)**

Note: Figure in Parenthesis shows the percentage of the beekeepers within the type of beekeeping.
Source: Field Survey

Land Holding Size of the Beekeepers

The landholding size was categorized in five groups i.e. 1-10 acres, 11-20 acres, 21-30 acres, above31 acres and

landless. The total land owned by sampled households was estimated at 1477 acres with an average land holding size of 18.46 acres. The data regarding the land landholding size owned and managed by the beekeepers are presented in table 2. About 27.5 percent of the sampled households owned a land of a mean of 7.81 acre, 15 % had 18.33 acre, 10% had 28.125 acres, 7.5% had 143.33 acre and 40% beekeepers of the sample size were landless. The report also indicates that it is possible to conduct beekeeping without being owner of land. The result of the study is similar to the findings of Ojo (2004) who observed and identified that beekeeping requires little or no land or space as hives can be placed on trees, waste land or on any flat roof tops.

Table 2: Distribution of Beekeepers on their Land Holding Size (N= 80)

S.#	Landholding Size (Acres)	Non Commercial Beekeepers N (%)	Commercial Beekeeper N (%)
1	1-10 Acres	12(54.5)	10(45.5)
2	11-20 Acres	5(41.6)	7(58.4)
3	21-30 Acres	7(87.5)	1(12.5)
4	Above 30 acres	3(50)	3(50)
5	Landless	11(34.4)	21(65.6)
	Total	**38(47.5)**	**42(52.5)**

Note: Figure in Parenthesis shows the percentage of the beekeepers within the type of beekeeping.

Source: Field Survey

Non-Beekeeping Occupation of the Beekeepers

As depicted in table-3, with respect to non-beekeeping occupation of beekeepers, 26(32.25%) beekeepers were Government employee, 24(30%) respondents were reported as labor,11(13.75%) were involved in farming, 9 (11.25%) were carpenters and 10(12.5%) beekeepers responded as Shopkeeper. Furthermore, the results indicate that not only farmers but also others could conduct beekeeping in parallel with their major activity for additional income. The result of the study is similar to the findings of On wbuya (2004)and Saha (2002) that beekeeping can be taken as a hobby, a social booster and can be practiced by those who are not conventional farmers and can be easily practiced by anyone with many other livelihood activities.

Table 3: Distribution of Beekeepers on their Non-Beekeeping Occupation (N= 80)

S.#	Occupation	Non Commercial Beekeepers N (%)	Commercial Beekeeper N (%)
1	Gov.:Employee	19(73)	7(27)
2	Labor	10(41.7)	14(58.3)
3	Farming	2(18.2)	9(81.8)
4	Carpentry	0(0)	9(100)
5	Shopkeeper	7(70)	3(30)
	Total	**38(47.5)**	**42(52.5)**

Note: Figure in Parenthesis shows the percentage of the beekeepers within the type of beekeeping.

Source: Field Survey

Bee Hives Owned by the Beekeepers

On average the number of bee hives in Tehsil Salarzai was (87.44 hive/household) ranges 2-416 hives and 27 beekeepers were involved in beekeeping enterprise, while 61.23 hives/household ranges 2- 665 involving 26 beekeepers in Thesil Nawagai followed by 32.70 hives/household ranges 2-214 hives having 27 beekeepers in Tehsil Khar. However, 21 beekeepers (26.25%) had less than 5 hive with a mean of 2.19 per household, 26.25 % had 5 to 30 bee hives with a mean of 18.23 hives, 20% beekeepers had 31 to 60 beehives with a mean of 45.18 hives, 12.5% had 61 to 120 beehives with a

mean of 90.6 hives while 15% had 121 and above hives with a mean of 231.5 hives per household as per data presented in Table no. 04.

Table 4: Distribution of Beekeepers on their Bee Hives Holding size (N= 80)

S.#	Hives holding Size (No. Hive)	Non Commercial Beekeepers N (%)	Commercial Beekeeper N (%)
1	Less than 5 hive	20(100)	0(0)
2	5-30 hive	17(81)	4(19)
3	31-60 hive	0(0)	16(100)
4	61-120 hive	0(0)	10(100)
4	121 & Above hive	0(0)	12(100)
	Total	**38(47.5)**	**42(52.5)**

Note: Figure in Parenthesis shows the percentage of the beekeepers within the type of beekeeping.

Annual Pre-Beekeeping Income Verses Post-Beekeeping Income of the Beekeepers

The total annual Pre-Beekeeping income of the sample size in the study area was Rs.14424000 and the mean per capita gross Pre-Beekeeping income of beekeepers in the study area was Rs.180300 per household per annum. While the total annual Post-Beekeeping income of the sample size was Rs.42182000 and the mean per capita gross Post-Beekeeping income of beekeepers was Rs.527275 per household per annum. The result presented in table # 05 shows that per capita annual Post-Beekeeping income of the beekeepers was 34.19% higher than the per capita annual Pre-Beekeeping income of the beekeeper (Rs.527275 verses Rs.180300). However, per capita annual Post-Beekeeping income of the beekeepers was 41.5% higher than the per capita annual income of the national level (Rs.527275 verses Rs.308364). The result of the study correlates to the findings of (Muzaffar, 2000), Ojo (2004) and Onwbuya (2004) that beekeeping is a profitable business and contributes to the incomes of the household and economy of the nation. Therefore beekeeping proved to be a significant business after applying paired sample t test for comparison of both phases (See Annex-1)

Table 5: Pre and Post Beekeeping Annual Income of the Beekeepers

	PAIRED DIFFERENCES								
	Total (N)	Mean	Std. Deviation S.D	Std. Error Mean	Confidence Interval		T	DF	Sig. (2-Tailed)
					Lower	Upper			
Pair 1 Pre-Beekeeping Income of the household	80	7.0758	8.4373	94332.3	3.40351	7.14199	5.615	79	.000
Post-Beekeeping Income of the household	80	1.8030	1.07636	12034.08					
	0	5.2728	8.39961	6177.08					
	PAIRED SAMPLE CORRELATION TEST								
	N	Correlation							Sig.
	80	.099							.383

Annual Pre-Beekeeping Expenditure Verses Post-Beekeeping Expenditure of the Beekeepers

The data reported in table no. 06 shows that per capita annual Post-Beekeeping Expenditure of the beekeepers was 63.7% higher than the per capita annual Pre-Beekeeping Expenditure of the beekeeper (Rs. 257912 verses Rs. 164200). The results further stated that the annual expenditures of the households were increased in terms of educational expenses of their children, construction of houses, buying vehicle and to fulfill other household needs. So as a result of additional

income and better living standard, their annual expenditures have increased. However, Paired Sample t test prove that beekeeping has significant positive impact on the expenditure level of the households after comparing Pre and Post-Beekeeping annual expenditures.(See Annex-II)

Table 6: Pre-Beekeeping and Post Beekeeping Annual Expenditures of the Beekeepers

	PAIRED DIFFERENCES								
	Total (N)	Mean	Std. Deviation S.D	Std. Error Mean	Confidence Interval		T	Df	Sig. (2-Tailed)
					Lower	Upper			
Pair 1 Pre-Beekeeping Annual Expenditure of the Beekeeper	80	1.6336	67183.54	7511.356	1.01645	77054.8	14.5	79	.000
Post-Beekeeping Annual Expenditure of the Beekeeper	80	2.53	78219.62	8745.22					
	0	0.8935	55249.515	6177.083					
	PAIRED SAMPLE CORRELATION TEST								
	N		Correlation						Sig.
	80		.721						.000

Income from Honey Marketing

The average annual gross income from beekeeping in the overall study area was Rs.527275/household (Rs.8864/hive/year). The total annual gross income from beekeeping in Tehsil Salarzai was Rs.21630000 (Rs.801111.1 /household/annum and Rs.9161.37/hive/annum) followed by Tehsil Nawagai where the total annual gross income from beekeeping was Rs.12059200 (Rs.463815.38/household/annum and Rs.8024/hive/annum (Table # 7). The total annual gross income from beekeeping inTehsil Khar was Rs.8492800 (Rs.314548.14/household/annum and Rs.9616 /hive /annum). The average annual income from beekeeping in Tehsil Salarzai area was 51.27% and was 31.14% higher than that of Tehsil Khar and 22.69% higher than Tehsil Nawagai because of high number of the hives kept by the beekeepers in Tehsil Salarzai.

Table 7: Honey Production and Household Gross Income

S/No	Location (Tehsil)	No. hives	Total honey Yield (Kg) KG/Year	Productivity (Kg/hive/yr)	Total Income from the Sale of Honey@ Rs.800/Kg (Rs)	Average Income (Rs) from the Sale of Honey / Beekeeper/ Year)	Percent Income from the Sale of Honey
1	Salarzai (27)	2361	27005	11.1	21630000	801111.1	51.3
2	Khar (27)	883	10616	12.02	8492800	314548.14	20.13
3	Nawagai (26	1592	15971	10.03	12059200	463815.4	28.6
Total	**(80)**	**4836**	**53592**	**11.08**	**42182000**	**527275**	**100**

Source: Field Survey Figures in parentheses show the number of beekeepers

Comparative Income from Beekeeping with Non-Beekeeping Income

The mean per capita gross non-beekeeping income of the beekeepers in the study area was Rs.1808300 per household per annum. The per capita income was highest in Tehsil Khar(Rs.197777/household/year) followed by Tehsil

Salarzai (Rs.177333.3/household/year) and Tehsil Nawagai (Rs.165230.8 /household /year). The per capita income was higher by 74.5 % from apiculture than non-beekeeping occupation (Rs.180300 vs. Rs.527275 /household/year). Out of the total income, 74.5% was from beekeeping and rest from non-beekeeping business. Income from beekeeping was highest in Tehsil Salarzai (81.4%), followed by Tehsil Nawagai (73.73 %) and Tehsil Khar (61.4%) as indicated in Table no. 8

Table 8: Contribution of Beekeeping in the Household Income

S.#	location	Pre-Beekeeping Average Income (Rs) per Beekeeper per year (A)	Range	Average Income (Rs) from the sale of honey/ beekeeper per year (B)	Post-Beekeeping Average income (Rs) per Beekeeper Per Year (A+B)	Beekeeping Contribution (%)
1	Salarzai (27)	177333.3	0-25000	801111.1	978444.4	81.4
2	Khar (27)	197777.8	0-50000	314548.14	512325.9	61.4
3	Nawagai (26)	165230.8	5000-30000	463815.4	629046.1	73.73
Total	**(80)**	**180300**	**0-500000**	**527275**	**707575**	**74.5**

Source: Field Survey Figures in parentheses show the number of beekeepers

Main Constraints and Problems of Beekeeping

The beekeepers identified the following multiple problem and constraints affect their beekeeping enterprise and have a negative impact on honey productivity and expansion of beekeeping in the study area i-e "expensiveness of beehives and beekeeping accessories" (35.8%), "invasion of hives by pests and bee diseases (23.3%), "lack of training about modern beekeeping techniques" (13.3%), "marketing problems" (9.2 %) "Lack of bee flora plants" (6.7%) "Lack of credit facility" (4.2%) "Lack of bee of bee colonies" (4.2%) and "poor assistance from NTFP office experts" (3.3%) as indicated in Table no. 9. The results are also in line with the findings of (Genersch, 2010) that honey bee colony loses and pest & pathogens are current threats to bees and beekeeping. Moreover, to check whether the identified problems and constraints are statistically significant, the binomial proportion test indicates that all the stated problems and constraints are statistically significant.

Table 9: Responses of Beekeepers to Different Types of Problems and Constraints

S.#	Types of Problems	No. Beekeepers Responded Accordingly	% Age	P Value
1	Invasion of hives by pests (such as ants, wasps and wax moth) and bee diseases	28	23.3	0.000*
2	Expensiveness of bee hives and beekeeping accessories	43	35.8	0.000*
3	Lack of training about modern techniques of bee keeping	16	13.3	0.000*
4	Marketing problems	11	9.2	0.000*
5	Poor assistance from the NTFP Office experts	4	3.3	0.033**
6	Lack of bee colonies	5	4.2	0.007*
7	Lack of flowering plants (especially *Zizyphus sativa* and *Accacia modesta*)	8	6.7	0.000*
8	Lack of credit facilities	5	4.2	0.007*
Total		**120**	**100**	

Note: Percentage and number exceeded due to multiple answers.

Note: *indicates that the factor is significant at 1% level of significance and ** indicates that the factor is significant at 5% level of significance.

CONCLUSIONS

It is concluded from the study that beekeepers have got the capacity to improve their livelihood in terms of better education, health, living standards, infrastructure, domestic demands and productive investments from beekeeping. The annual mean household income was significantly reported higher than that of non-beekeeping sources. Similarly per capita annual Post-Beekeeping Expenditure of the beekeepers was higher than per capita annual Pre-Beekeeping Expenditures. Moreover the major constraints listed by the beekeepers during the survey were shortage of bee flora, feeding of beehives in extreme weather conditions, bee forage enemies ,lack of credit facility, extension services, marketing and poor support from the concerned department. However the study result revealed that honeybee keeping is profitable activity having positive impact on the household income of the beekeepers.

RECOMMENDATIONS

- It is desirable to strengthen and expand the beekeeping in the study area and private investors should invest in the sector since the sector is profitable both financially and economically.
- Restoration and expansion of bee flora plants (*Zizyphus sativa and Acacia modesta*)& marketing localities maximize the honey productivity and profitability in the study area.
- Provision of adequate loans without interest or grant of sufficient number of beehives free of cost to promote a sustainable bee keeping practices.
- Awareness should be created by the concerned bodies for proper, planned and scientific use of insecticides and pesticides to avoid invasion of beehives.
- Steps to be undertaken to launch training programs & awareness schemes for non-beekeepers to adopt this profitable activity as a commercial source of income.

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APPENDICES

ANNEX-I

Pre and Post-Beekeeping Annual Income of the Household

Paired Sample Statistics

	Mean	N	Std. deviation	Std. Error Mean
Pair 1 Pre-Beekeeping annual income of the household	7.0758E5	80	8.4374E5	94332.28352
Post-Beekeeping annual income of the household	1.8030E5	80	1.07636E5	12034.08135

Paired Sample Correlation

	N	Correlation	Sig
Pair 1 Pre- Beekeeping annual income of the household & Post- Beekeeping annual income of the household	80	.099	.383

Paired Samples Test

	Paired Differences				
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
				Lower	Upper
Pair 1 Pre- Beekeeping annual income of	5.2727E5	8.39961E5	93910.44565	3.40351E5	7.14199E5

the household & Post-Beekeeping annual income of the household					

Paired Samples Test

	T	Df	Sig.(2-Tailed)
Pair 1 Pre- Beekeeping annual income of the household – Post-Beekeeping annual income of the household	5.615	79	.000

ANNEX-II

Pre and Post-Beekeeping Annual Expenditure of the Household

Paired Sample Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 Pre-Beekeeping annual income of the household	1.6336E5	80	67183.52792	7511.34677
Post-Beekeeping annual income of the household	2.5271E5	80	78219.61840	8745.21920

Paired Sample Correlations

	N	Correlation	Sig
Pair 1 Pre- Beekeeping annual income of the household & Post- Beekeeping annual income of the household	80	.721	.000

Paired Samples Test

	Paired Differences				
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
				Lower	Upper
Pair 1 Pre-Beekeeping annual income of the household- Post-Beekeeping annual income of the household	8.9350E4	55249.51457	6177.08352	1.01645E5	77054.82282

Paired Samples Test

	T	DF	Sig.(2-Tailed)
Pair 1 Pre- Beekeeping annual income of the household- Post-Beekeeping annual income of the household	14.465	79	.000